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ACTIVITY DENSITY OF SOIL MESOFAUNA ASSOCIATED WITH POTATO FIELDS IN MENOFIYA GOVERNORATE, EGYPT

Wafai Z. A. Mikhail* and Abd-El-Khalek M. Hussein**
* Department of Natural Resources, Institute of African Research & Studies, University of Cairo, Egypt.
** Plant Protection Research Institute, Agricultural Research Centre, Dokki, Giza, Egypt

ABSTRACT

An experiment was conducted at Tambisha village, middle Delta, Menofiya Governorate, during the period between February and May 1995, in order to investigate the soil mesofauna associated with potato fields. The soil mesofauna were collected by the pitfall trap method. Data of activity density of soil mesofauna taxa were treated by multivariate statistical methods: correspondence analysis and ascending hierarchic classification. Results obtained show that the most dominant taxa are Poduridaeand Entomobryidae (Collembola), and spiders. However the main trophic (functional) groups of the soil mesofauna are well represented in the present study.

INTRODUCTION

The study of populations of soil mesofauna in agro-ecosystems deserves its own merit, since these studies reflect the status of such agro-ecosystems. Zedan *et al.* (1993) studied the recovery of soil mesofauna in a cotton field after treatments with insecticides at Etsa, Fayoum, Egypt. Mikhail *et al.* (1995) studied the effect of bio-pesticides and chemical insecticides on some non-target taxa of soil fauna associated with clover cultivations at Demo, Fayoum. These are examples of such studies used to monitor changes in population size and to examine the relation of population size and environmental covariates (Link *et al.*, 1994), and to provide essential data sets for conservation and resource management (Oliver and Beattie, 1993).

The present work on potato fields is one of a series of an extensive study applied on different field crops and at different seasons at Tambisha Village, Menofiya Governorate in order to study the community structure of soil mesofauna under such field crops, and to monitor differences in numbers of species and of individuals owing to the type of cultivated crops and season of cultivation.

MATERIAL AND METHODS

The experiment was conducted at Tambisha village, Menofiya Governorate, in the middle of the Nile Delta during the period from February 1995 to May 1995. The study area consists of 10 feddans (1 feddan = 1.038 acre) cultivated with potatoes.

The soil mesofauna were collected from the study area by the pitfall trap method as described by Southwood (1978) and Slingsby and Cook (1986). Twelve traps were used monthly during the study period. In this method, the number of individuals trapped is primarily dependent on their locomotory activity (Greenslade and Greenslade 1983, Kromp 1990, Mikhail 1993). These are called activity densities rather than population densities (Kromp 1990, Mikhail 1993, Mikhail *et al.* 1995) and can not be related to the abundance per unit area (Kromp 1990) but are taken as number per trap (Mikhail 1993, Mikhail *et al.* 1995).

Data of the activity density of the soil fauna were treated by multivariate statistical methods: correspondence analysis CA (Greenacre 1984) and ascending hierarchic classification AHC (Roux 1985). The computer calculations for CA and AHC were carried out at University of Cairo using DATAVISION programme 1.2 (Roux 1987) developed for APPLE IIe in BASIC.

RESULTS

The following results are based on 3641 trapped individuals representing 21 species and/ or higher taxa of the soil mesofauna (Table 1) collected during the present study.

Table 2 and Fig. 1 show results of the breakdown of the soil mesofauna collected during the present study into the main trophic (functional) groups. It is noticed that detritivores were higher at the beginning of sampling then decreased gradually towards the end of the study period. Carnivores and herbivores were less frequent than detritivores at the beginning of the sampling period and increased gradually towards the end of the study period, where carnivores became more abundant than herbivores.

Fig. 2 shows graphical representation of the application of CA and AHC methods to the data of Table 1. Fifty percent of the total variance is associated with the first (horizontal) axis and 26 % with the second (vertical) one. The horizontal axis separates the early sampling period (February and March) from those of the late sampling dates of the present study which lasted for 4 months, February through May. Sampling dates of the first two months are more or less similar to each other and grouped together in the middle of the ordination graph with their characteristic taxa. These taxa were *Tropinota squalida* (Coleoptera, Scarabaeidae), spiders, *Apis mellifera* (Hymenoptera, Apidae), *Agrotis ypsilon* (Lepidoptera, Noctuidae), Isopoda, *Aphis* spp. (Homoptera, Aphididae), Lepidoptera larvae, *Liogryllus bimaculatus*

(Orthoptera, Gryllidae), Entomobryidae and Poduridae (Collembola) and Carabidae (Coleoptera). The other two months are separated from each other along the second axis. The sampling dates of April are grouped together at the top of the ordination graph and were generally characterized by Staphylinidae, *Morellia nilotica* (Diptera, Muscidae), *Syrphus corollae* (Diptera, Syrphidae), Braconidae (Hymenoptera), mosquitoes and earthworms. At the bottom of the ordination graph, sampling dates of May are grouped together and were characterized by Curculionidae, *Coccinella undecimpunctata* (Coccinellidae, Coleoptera), snails, and Acriididae.

DISCUSSION

The complex influence of site and cultivation specific parameters as well as the crop type on the community structure of the soil mesofauna appears to create a rather accidental pattern of soil mesofauna frequencies in agro-ecosystems. The community structure of the soil mesofauna of the present study comprises 3641 trapped individuals representing 21 species and/ or higher taxa. These figures are much greater than 10 taxa associated with cotton cultivation (Zedan *et al.*, 1993) and 17 taxa associated with clover cultivations (Mikhail *et al.*, 1995). Potatoes fields of the present study had dense vegetation cover with large leaves which provide shelter and diet for soil animal taxa.

Poduridae and Entomobryidae (Collembola) , and spiders were the dominant taxa during the period of the present study. In spite of the fundamental structural changes in farming practices (farmland consolidation, deep ploughing, use of chemicals) the abundance of these taxa has not changed during the cultivation period. Same results were obtained by Zedan *et al.* (1993) and Mikhail *et al.* (1995). Spiders and Collembola under cotton cultivations were tolerant to insecticide applications during the period of the study between June and October (Zedan *et al.*, 1993) and under clover cultivation during the period of the study between December 1992 and February 1993 (Mikhail *et al.*, 1995), and may increase in numbers after insecticide applications (Crossley *et al.*, 1992).

Ghabbour (1991) pointed out the importance of studying the trophic (functional) groups of the soil mesofauna populations in order to evaluate the structural composition of these groups in different ecosystems. In the present study, the trophic groups: detritivores (essentials for soil fertility), herbivores (potential agricultural pests), and carnivores (natural enemies of herbivoers) were well represented at all months. These results suggest that the soil mesofauna of potato cultivations has complex food chains, and that the soil fauna community is highly adapted to agricultural practices. On the other hand, the vegetation texture (i.e. plant density, species, and structural composition) may influence the abundance of a herbivore by affecting its movement, altering the suitability of host plants (Coll and Bottrell 1994). It may also create conditions suitable for the abundance of each of the Poduridae and Entomobryidae (both are detritivores) as well as herbivores and carnivores.

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Table (1) List of species and/or higher taxa of soil mesofauna collected during the period between February 1995 and May 1995.

Taxa	21 Feb	28 Feb	7 Mar	14 Mar	21 Mar	28 Mar	11 Apr	18 Apr	26 Apr	2 May	9 May
Isopoda	2									1	
Collembola											
Poduridae	990	243	69	65	600	400	15	14	19		13
Entomobryidae	54	9	32	27	90	70	20	22	29	1	3
Orthoptera											
Gryllidae											
Liogryllus bimaculatus			1								
Acriididae											1
Coleoptera											
Carabidae					1	1					
Staphylinidae	1						5	9	6		
Coccinellidae											
Coccinella undecimpunctata				1						4	10
Curculionidae			1					1		1	5
Scarabaeidae											
Tropinota squalida	21	5	6	4	2						
Homoptera											
Aphididae											
Aphis spp.	52	3	28	21	65	19	3	5		6	
Lepidoptera											
Noctuidae											
Agrotis ypsilon	4							1	2		4
Lepidoptera larvae			1								

Table (1) Continued.

Taxa	21 Feb	28 Feb	7 Mar	14 Mar	21 Mar	28 Mar	11 Apr	18 Apr	26 Apr	2 May	9 May
Diptera											
Syrphidae											
Syrphus corollae				1	1	1	4	7	3	3	
Muscidae											
Morellia nilotica	1				1		11	17	6	5	
Culicidae									3		
Hymenoptera											
Braconidae						1	15	51	8		
Apidae											
Apis mellifera	3	1	3	2	1	12					
Earthworms							1	1	1	1	
Snails										2	
Spiders	34	13	55	43	29	36	24	38	11	19	84
Total	1162	274	196	164	790	540	98	166	88	43	10

Table (2) Breakdown of soil mesofauna into trophic (functional) groups

Group	Feb.	Mar	Apr.	May
Detritivores	1325	1370	174	33
Herbivores	63	154	85	13
Carnivores	48	166	93	117

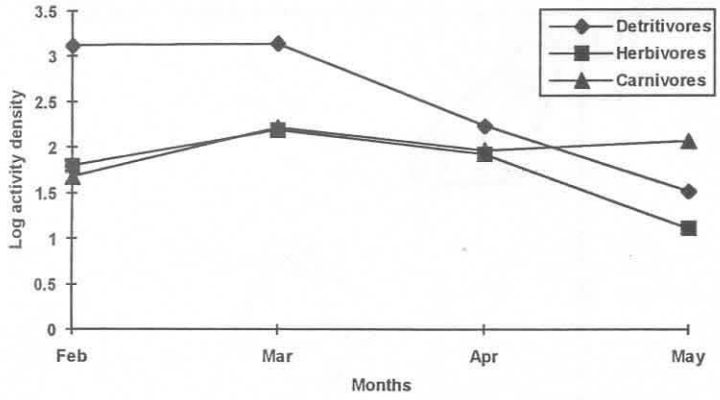

Fig. (1) Trophic (functional) groups of soil mesofauna in a potato fields.

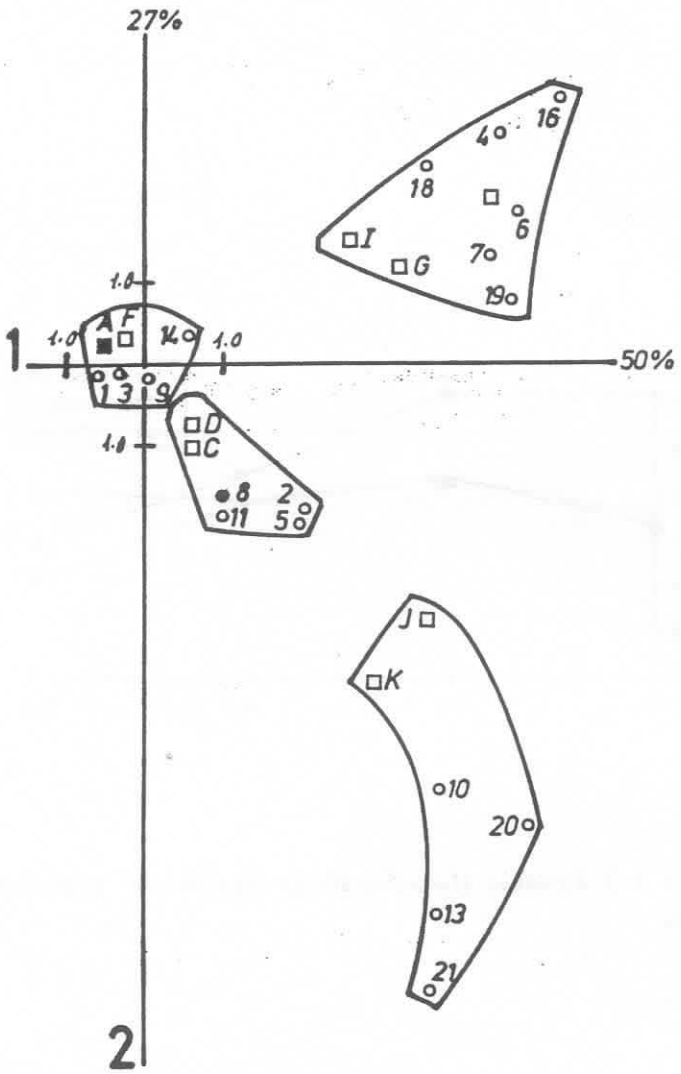

Fig. (2) Graphical representation of the application of CA and AHC methods to data of Table (1). Dates, open squares, letters A-K: A, 21 Feb ; B, 28 Feb ; C, 7 Mar ; E, 21 Mar ; F, 28 Mar ; G, 11 Apr ; J, 2 May ; K, 9 May. Species, open circle, numbers 1-21: 1, *Tropinota squalida*; 2, spider ; 3, *Apis mellifera* ; 4, Staphyllinidae ; 5, *Agrotis ypsilon* ; 6, *Morellia nilotica* ; 7, *Syrphus corollae* ; 8, Isopoda ; 9, *Aphis* spp. ; 10, Curculionidae ; 11, Lepidoptera larvae ; 12, *Liogryllus bimaculatus* ; 13, *Coccinella undecimpunctata* ; 14, Entomobryidae ; 15, Logacnura ; 16, Braconidae ; 17, Carabidae ; 18, mosquitoes ; 19, earthworms ; 20, snails ; 21, Acriididae. The solid square contains : A, B, E, 15, and 17 ; the solid circle contains 8 and 12 .

المجلة المصرية لفعم الحيوان
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كثافة نشاط عشائر حيوانات التربة المتوسطة الحجم فى زراعات البطاطس بمحافظة المنوفية

وفائى زكى عازر ميخائيل[١] ، عبد الخالق محمد حسين[٢]

(١) قسم الموارد الطبيعية – معهد البحوث والدراسات الأفريقية – جامعة القاهرة

(٢) معهد بحوث وقاية النبات – مركز البحوث الزراعية – الدقى – الجيزة

أجريت هذه الدراسة فى قرية طمبشا بوسط الدلتا بمحافظة المنوفية وذلك خلال الفترة من فبراير إلى مايو ١٩٩٥ ، وذلك لدراسة كثافة نشاط عشائر حيوانات التربة المتوسطة الحجم والمصاحبة لزراعات البطاطس. وقد جمعت حيوانات التربة بواسطة طريقة مصائد الحفر. عولجت النتائج إحصائيا بطرق التحليل الإحصائي المتعدد المتغيرات: التحليل التوافقى والتقسيم الهيراركى. أظهرت نتائج الدراسة أن مجموعات حيوانات التربة المتوسطة الحجم السائدة فى زراعات البطاطس وفى خلال فترة الدراسة هى عائلتى بوديوريدى وانتيموبريدى وكلاهما يتبع رتبة الكولمبولا (حشرات) وكذلك العناكب. كما أظهرت الدراسة أيضا أن المجموعات الوظيفية الأساسية وهى آكلات النثار والعاشبات الدقيقة الحجم والمفترسات ممثلة تمثيلا جيدا خلال اشهر الدراسة مع ملاحظة أن مجموعة آكلات النثار تزيد عن المجموعتين الأخريين (العاشبات الدقيقة الحجم والمفترسات) ، كذلك وجد أن أعداد الكولمبولا والعناكب لم تتأثرا بالمبيدات المستخدمة أثناء زراعة محصول البطاطس.